Part 15 Emission Limits Extrapolated to Land Mobile Distances From Power Lines

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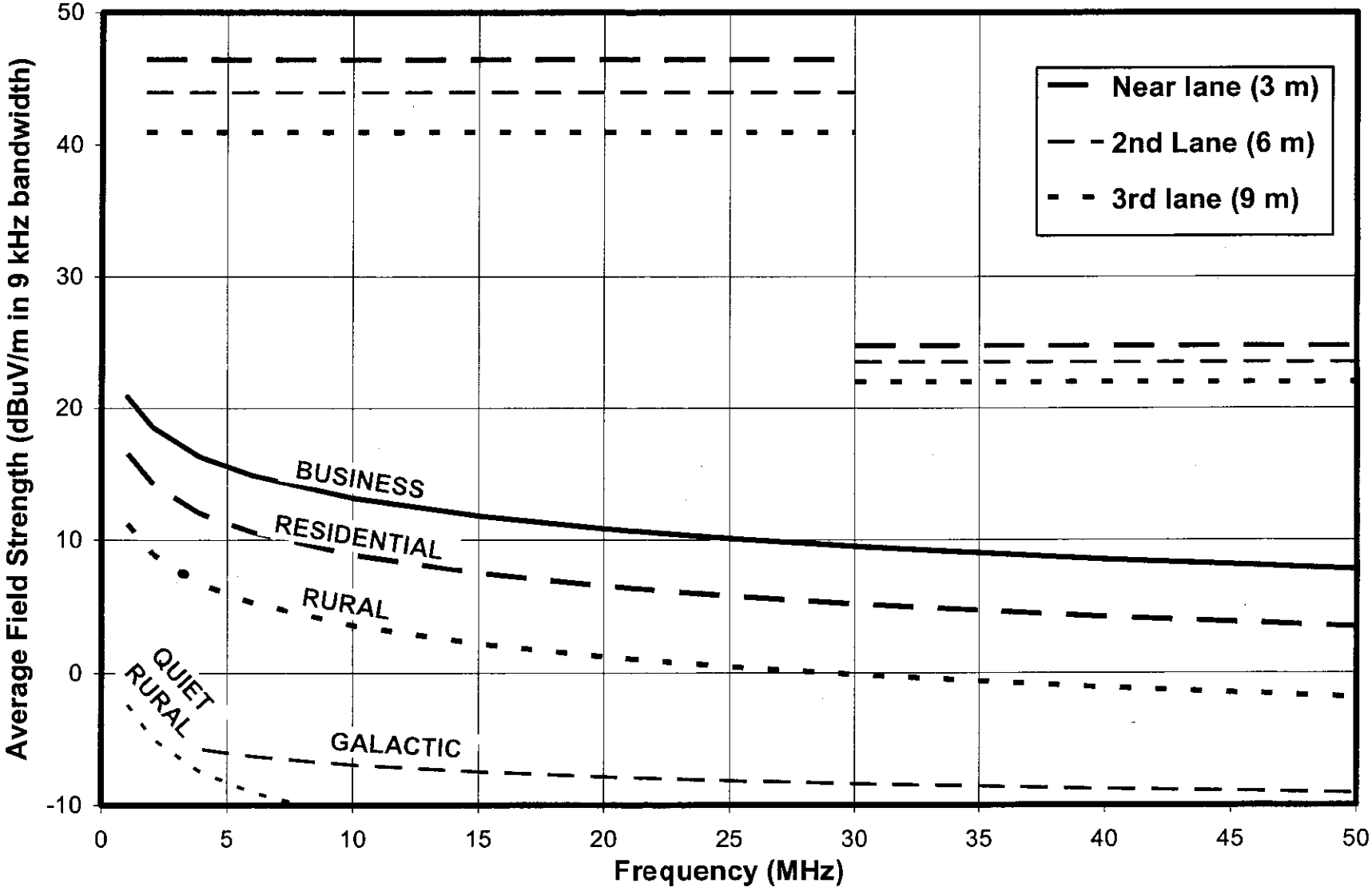

Mobile Radio Noise Floor Rise ([I+N]/N) Permitted by Current BPL Emission Limits

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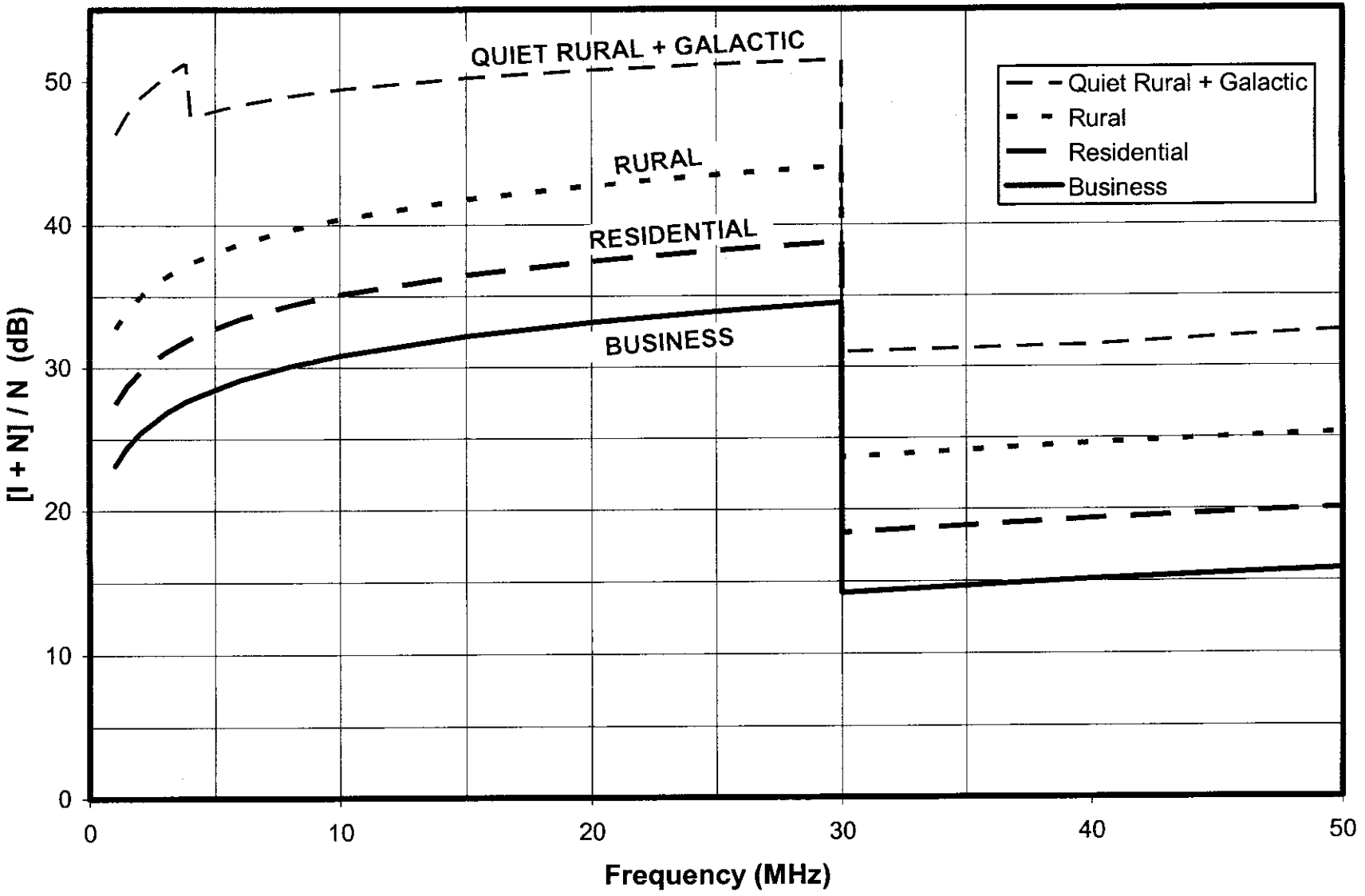

NTIA Results

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of Part 90 Land Mobile Licensees

by Band in 2-MHz Increments

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Other Issues

Skywave (<30 MHz)

New Information Arguing for Caution on HF BPL

What To Do

NON-PUBLIC / FOR INTERNAL USE ONLY

HF Issues and Options

Low VHF Options

BPL Spectrum Tradeoffs and Proposal

BPL Emission Tests
Near Raleigh, North Carolina
June 28 – July 2, 2004

August 4, 2004

Steve Martin & Andy Leimer – FCC Laboratory

On site support: Joe Husnay & Luther Bolden – FCC Norfolk Resident Agent Office
Radio, GPS, S/W, & expertise: Dave Larrabe & Jim Higgins – FCC Monitoring Station

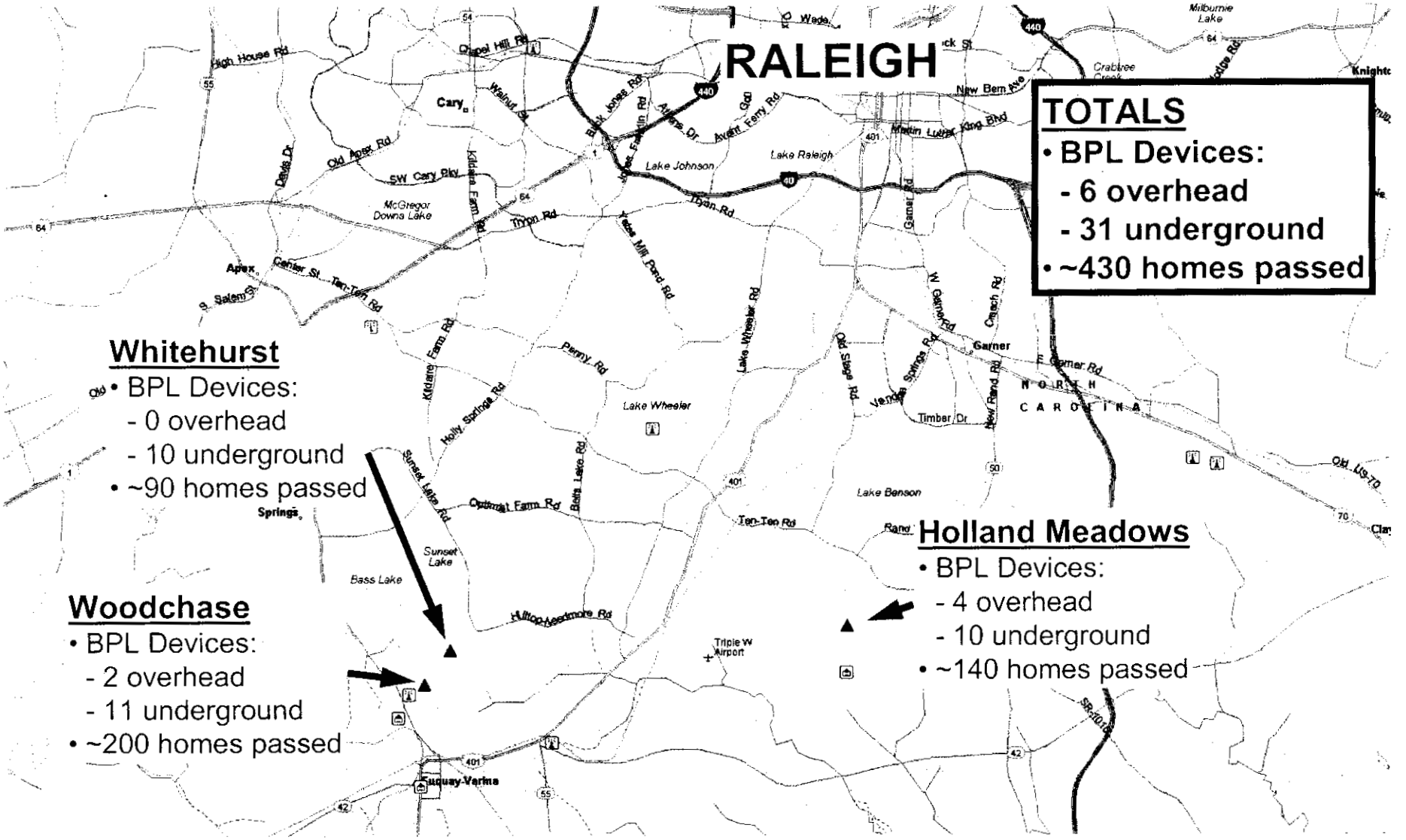
Outline

- Introduction
- Compliance with Emission Limits
- Emissions at Unprotected (Un-notched) Frequencies
- BPL Notch Effectiveness
- Fixed Amateur Sites

Introduction

- **Tests of emissions from BPL systems deployed near Raleigh, NC were performed in response to complaints of interference to**
  - mobile amateur radio in the vicinity of three BPL installations
  - three fixed amateur installations at homes located 0.4 to 0.7 miles from overhead BPL installations

Amperion/Progress-Energy BPL Deployments Near Raleigh



BPL Device Frequencies in Raleigh Deployments

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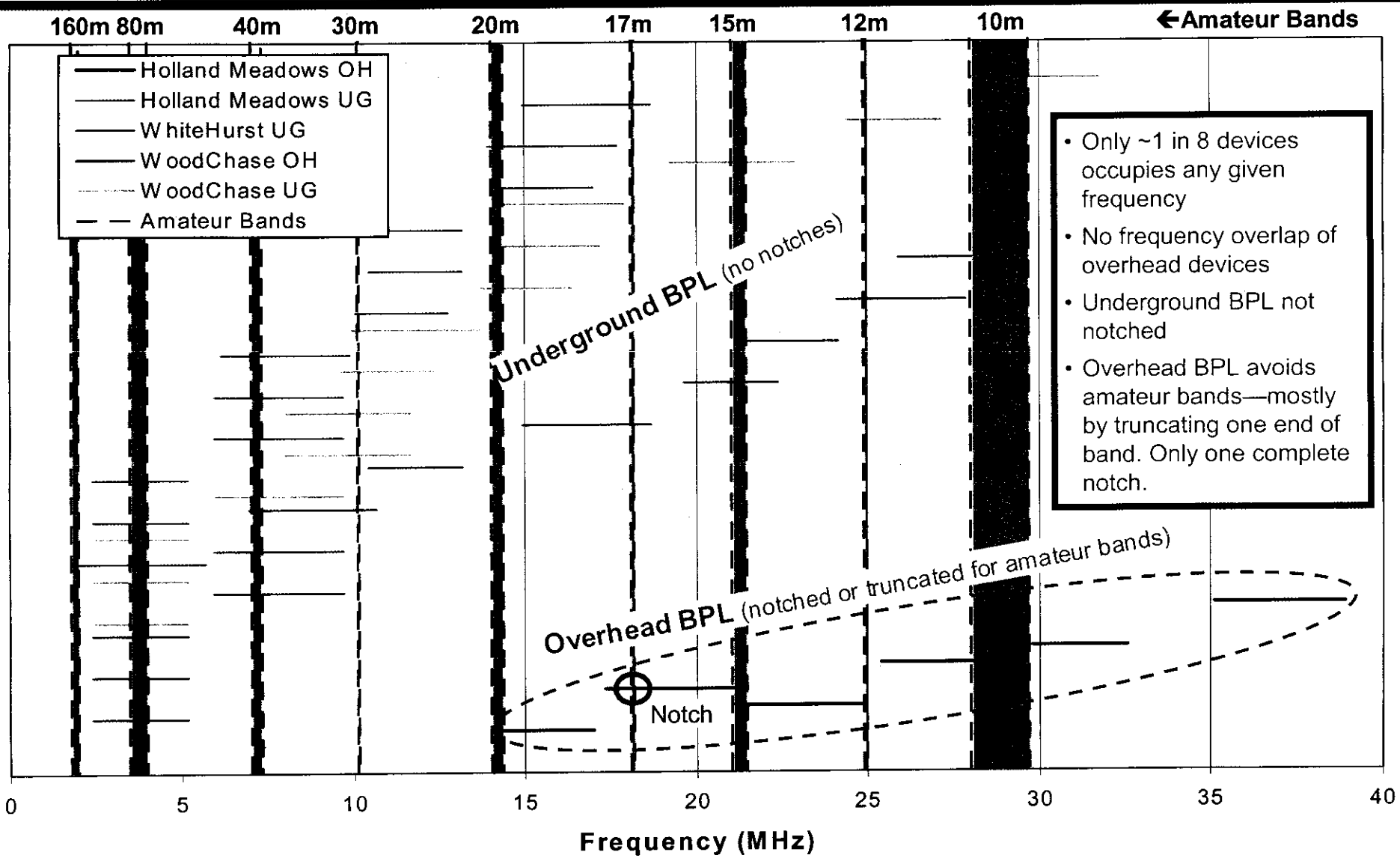

Amperion BPL System

- **Unusual Design Characteristics**
  - Frequency division multiplexing with relatively small bandwidth per device (2.75 or 3.75 MHz)
  - WiFi link to customers--No use of low voltage lines
    - Minimal emissions from building wiring → few above-ground emission sources where power lines are underground
- **Other Characteristics**
  - OFDM
  - Remote band selection & Remote "notching" by omitting OFDM carriers

Network Topology at Holland Meadows

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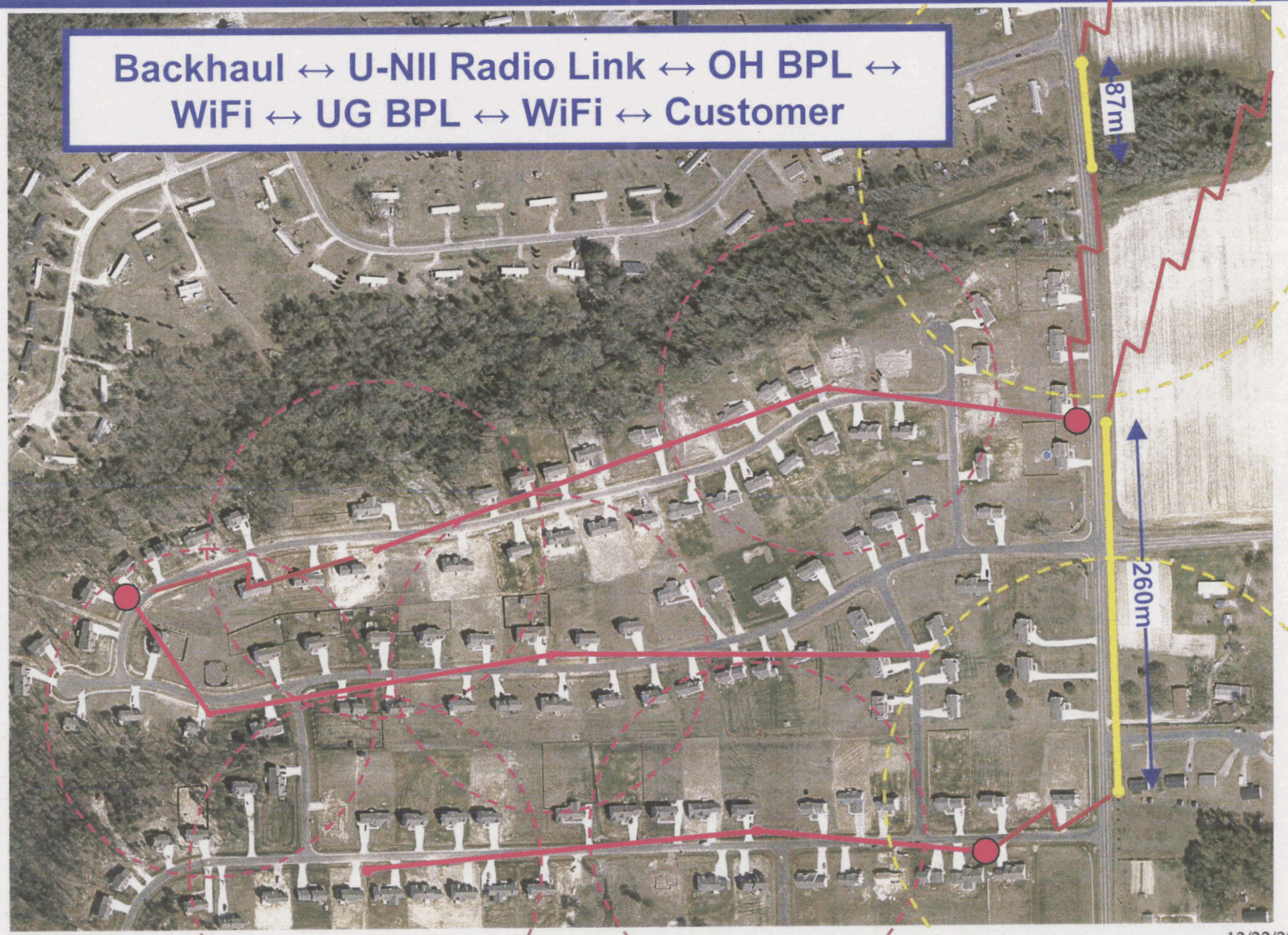
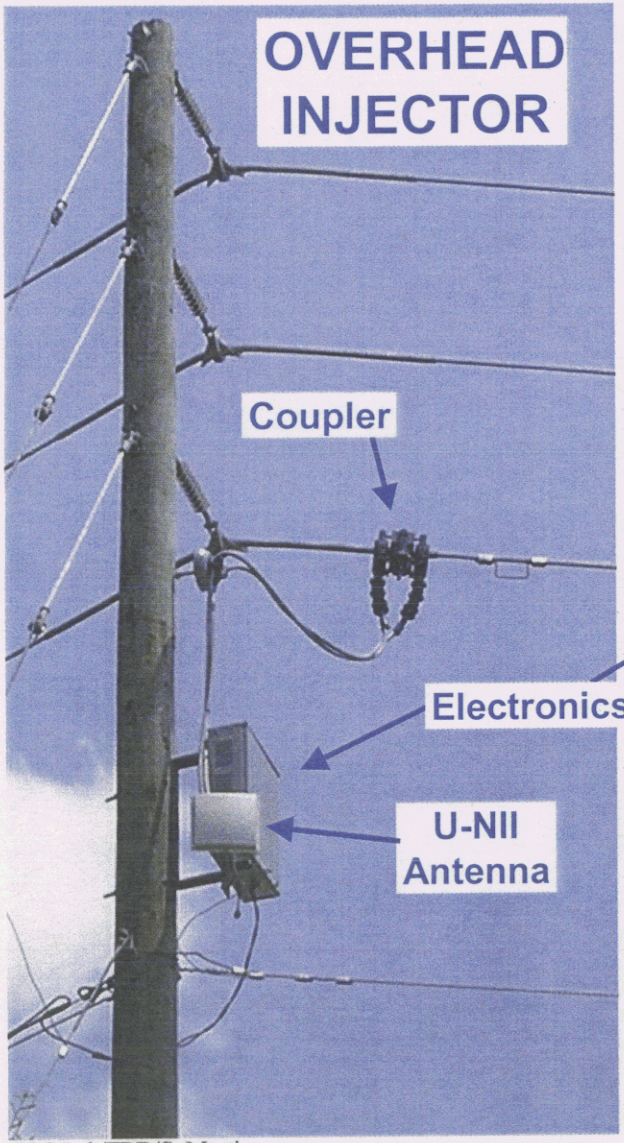
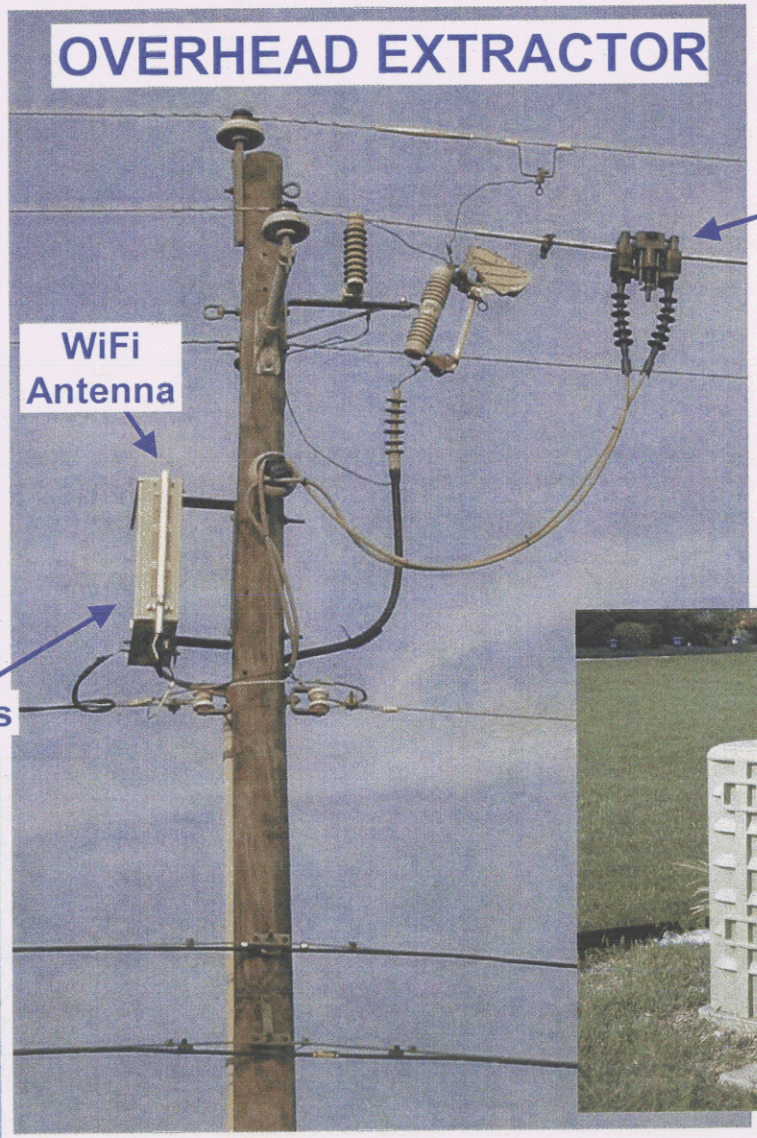
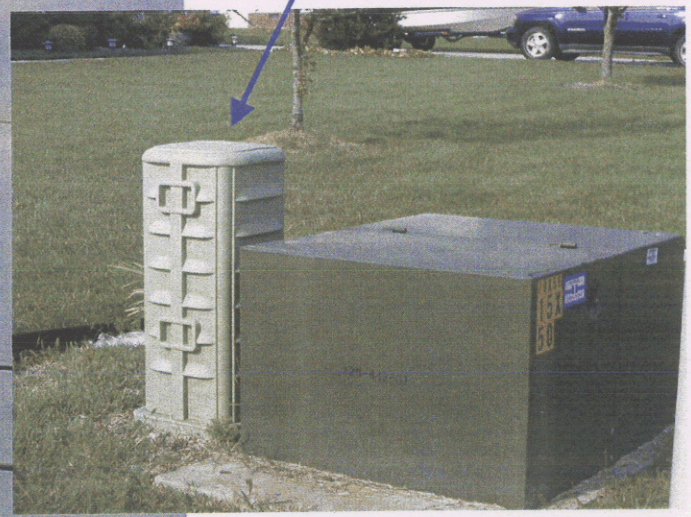


Amperion BPL Hardware



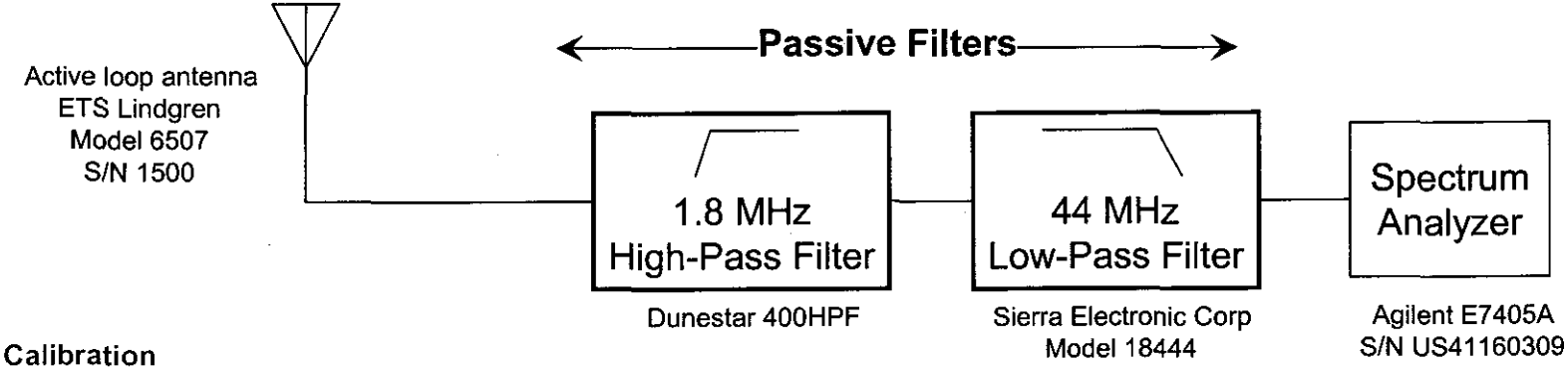


Housing for in-ground BPL device w/internal WiFi antenna



Compliance with Emission Limits

Test Description for Compliance Measurements



- **Calibration**
  - The combination of all cables & filters was calibrated, as a function of frequency, using the spectrum analyzer's tracking generator
- **Measurement locations**
  - Antenna height: 1 meter
  - Horizontal offset from the power line on which the BPL signals were injected: 10-meters (on the tobacco-field side of the power line rather than on the road side, for physical safety)
  - Distance down line from BPL coupler: 0, 0.25, 0.5, 0.75, & 1* wavelength (southwest of *coupler at Woodchase*; *south of coupler at* Holland Meadows)
    * - At Woodchase, the final measurement was 0.87 wavelength down line, due to a large mud puddle at one wavelength. Wavelengths were based on the BPL device center frequencies of 23.2 MHz at Woodchase and 19.2 MHz at Holland Meadows.
  - Antenna orientations
    - Two orientations used at both sites: (1) Plane of loop vertical & parallel to power line, (2) plane of loop vertical & perpendicular to power line
    - *Third orientation (plane of loop horizontal)* was tested at only one Woodchase location and yielded lower field strengths
- **Procedure**
  - Power average spectra were measured at each antenna location & orientation. Antenna was returned to the location exhibiting the maximum field strength and power average spectrum was repeated. CISPR quasi-peak measurement was performed in limited band around frequency of maximum emission
- **Distance extrapolation to 30-meter distance at which emission limit is specified**
  - 40 log of slant range from antenna to power line, based on optically-measured power line heights of 10.9 m at Whitehurst and 10.5 m at Holland Meadows
  - Extrapolation was applied to the emission limit rather than to the measured data, so that the plots indicate actual field strength observed at the antenna location

Compliance Tests on Overhead Injector on Slaughter Rd at Woodchase

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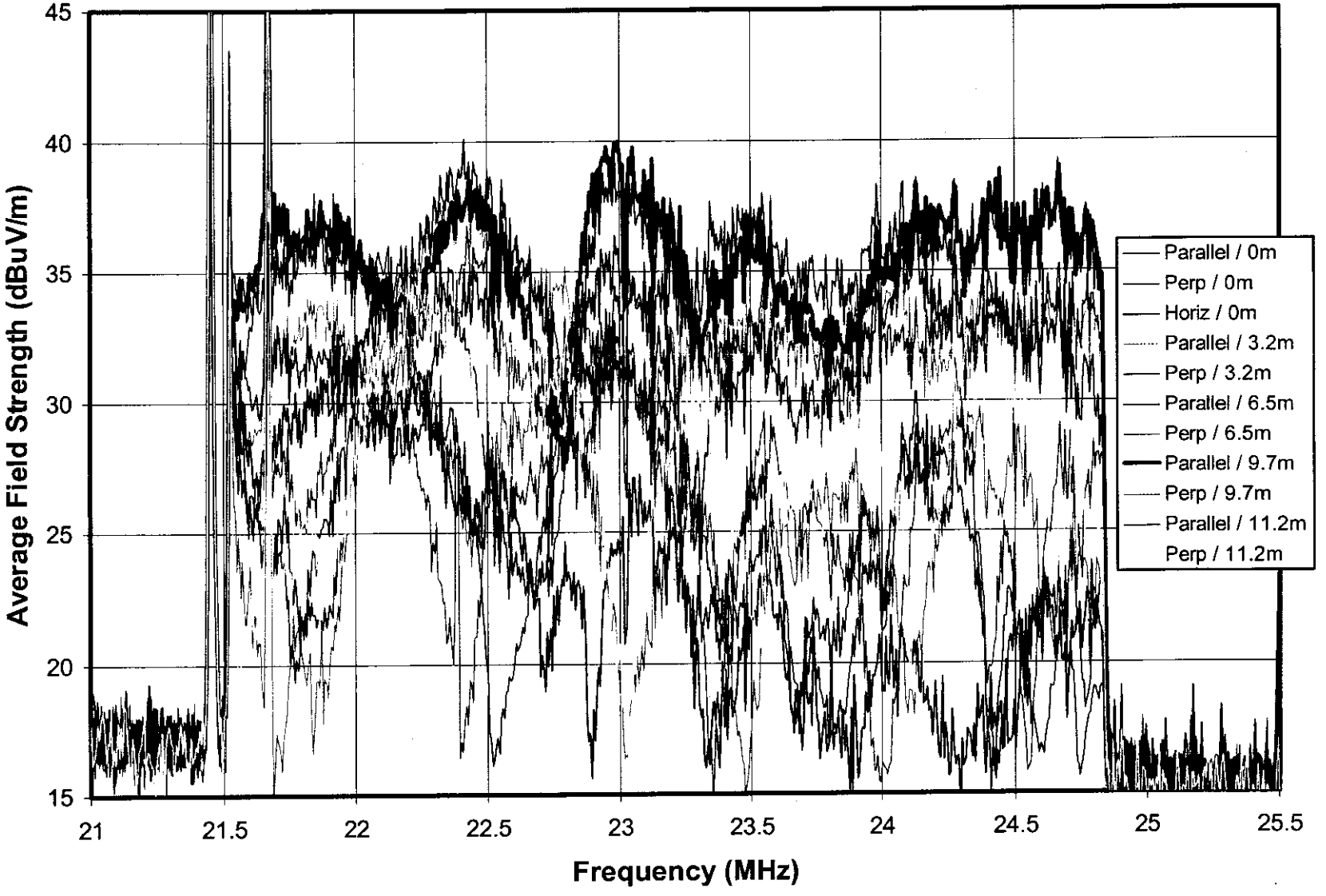
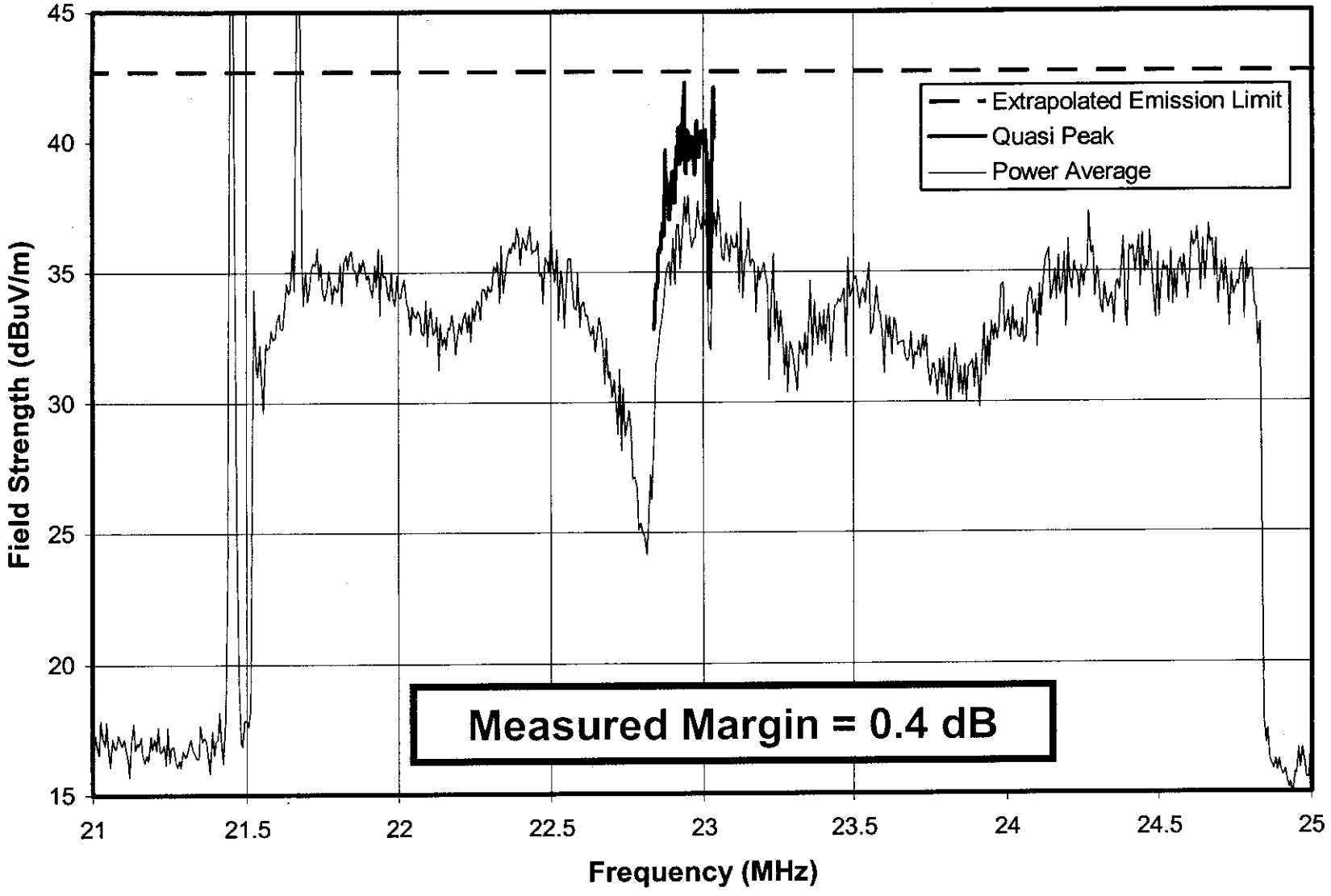
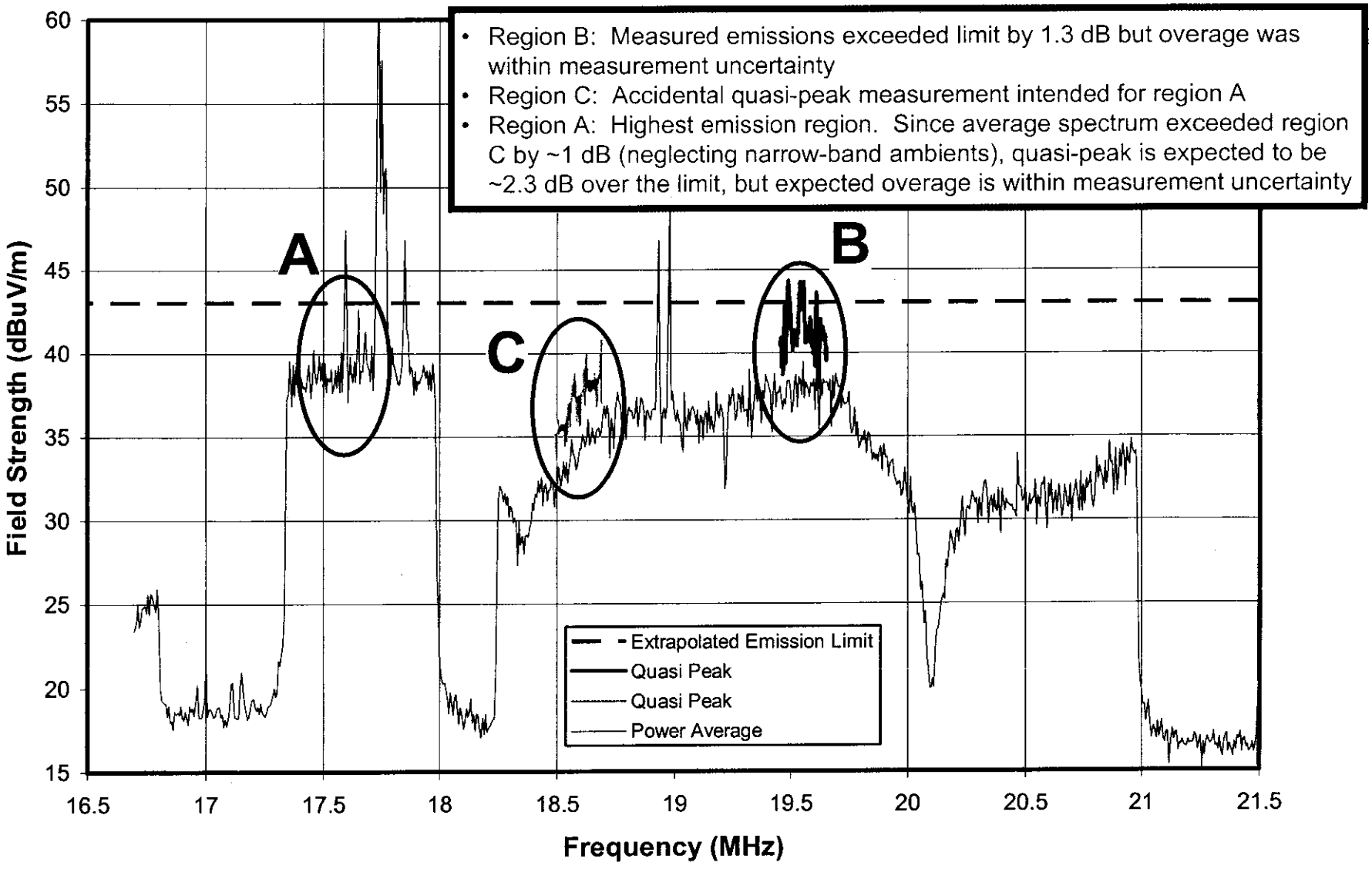


Compliance Tests on Overhead Injector on Slaughter Rd at Woodchase



Compliance Tests on 19.2-MHz Overhead Injector on Holland Church Rd



Compliance with Emission Limits

- **Compliance results**
  - BPL devices on overhead power lines
    - Tested two overhead "injectors" (in-band emissions only) – Emission levels are at compliant (within measurement uncertainty) BPL devices on underground power lines
    - Not tested, but compliance expected based on radio tests, which indicated much lower emissions from underground wiring than overhead wiring